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Title:

WELL STRUCTURE IN HIGH VOLTAGE DEVICE

Sung Kee Park

323, 2 Pyeongon-Ri, Hwanam-Myun
Sangioo-Shi
Kyungsangbuk-Do, Republic of Korea

WELL STRUCTURE IN HIGH VOLTAGE DEVICE

BACKGROUND

5 1. **Field of the Invention**

[0001] The present invention relates to a well structure in a high voltage device and, more particularly, to a well structure in a high voltage device capable of improving a well breakdown voltage (BVDSS) and preventing charge-up and latch-up at a substrate in the high voltage device used in a flash
10 memory.

2. **Discussion of Related Art**

[0002] In general, the flash memory is mainly classified into an NOR type and a NAND type depending on a shape in which memory cells are
15 connected to bit lines. A high voltage is used in the NAND type flash memory or the NOR type flash memory in order to perform a program operation or an erase operation. In order for the NAND type flash memory to perform the program operation or the erase operation, a voltage of about 20V is required. Further, in order for the NOR type flash memory to perform the program
20 operation or the erase operation, a voltage of about 14V is needed. In order to apply such high voltage to a cell region, a high voltage device is located in a peripheral circuit region.

[0003] In case of the NAND type flash memory, upon the program operation and the erase operation, a high voltage of about 20V is used as

described above. Such a high voltage is obtained through a high voltage device. The high voltage device has a PMOS transistor and a native transistor within the N-well. As the N-well and N⁺-pickup are applied a high voltage, it is required that the well breakdown voltage of the N-well itself be about 30V.

5 In other words, upon the program operation and the erase operation of the NAND type flash memory, in order for the high voltage device to stably apply the high voltage to the cell transistor, it is required that the well breakdown voltage of the high voltage device be 30V or higher. Even in case of the NOR type flash memory, it may well have a high well breakdown voltage even
10 though its value may be different from that of the NAND type flash memory.

[0004] FIG. 1 is a cross-sectional view illustrating a basic well structure in a conventional high voltage device. In order to have a high well breakdown voltage, an N-well 12 is formed in a P type substrate 11 and a P-well 13 spaced apart from the N-well 12 by a given distance is formed in the P type
15 substrate 11. In case of a structure in which the N-well 12 and the P-well 13 contact each other, the well breakdown voltage is about 18V. The high voltage device of this well structure could not be applied to devices that require the well breakdown voltage of 18V or higher, for example, the NAND type flash memory. Therefore, in case of the NAND type flash memory, the N-well 12 is
20 separated by a distance of 20 μm or greater from the P-well 13 when it is formed in the P type substrate 11. In more detail, in the N-well 12 within the P type substrate 11, a lateral diffusion becomes about 1 μm , the depletion region is abruptly formed at a low voltage and the depletion region is not increased at a voltage of over a given value, i.e., due to a high resistance of the P type

substrate 11. For this reason, a breakdown voltage of 40V or higher is kept at a distance of 20 μm or greater. As such, in case of the NAND flash memory, there occurs a problem where the high voltage device is formed by making the distance between the N-well 12 and the P-well 13 20 μm or greater. As the
5 density of the NAND type flash memory recently becomes higher, it is required that the distance between the N-well 12 and the P-well 13 be narrowed. In order to solve this problem, in the NAND type flash memory of 0.12 μm level, field stop implant region 14 using boron is formed in the P type substrate 11 between the N-well 12 and the P-well 13. From a simulation
10 shown in FIG. 3, however, it can be seen that the well breakdown voltage is low, about 23V, when the N-well 12 and the field stop implant region 14 are connected (0.0 μm). In FIG. 1, an unexplained reference numeral 15 indicates a field oxide film.

[0005] As described above, the conventional well structure in the high
15 voltage device has limitations in higher-integration of the flash memory or the semiconductor device that requires the high well breakdown voltage.

SUMMARY OF THE INVENTION

[0006] The present invention is contrived to solve the aforementioned
20 problems. The present invention is directed to provide a well structure in a high voltage device capable of improving performance and reliability of the device and realizing higher-integration of the device, by improving a well breakdown voltage and preventing charge-up and latch-up at a substrate.

[0007] One aspect of the present invention is to provide a well structure in a high voltage device, a well structure in a high voltage device, comprising; a first well formed in a substrate, the first well having an opposite conductive type from the substrate; a second well isolated from the first well, the second well having the same conductive type as the substrate; a field stop implant region formed between the first well and the second well and spaced apart from each of the first well and the second well by a given distance, the field stop implant region having the same conductive type as the substrate; and a pick-up region overlapped on the field stop implant region, the pick-up region having the same conductive type as the field stop implant region.

[0008] In the aforementioned of a well structure in a high voltage device according to another embodiment of the present invention, the substrate is a P type substrate.

[0009] In the aforementioned of a well structure in a high voltage device according to another embodiment of the present invention, the first well is an N-well into which phosphorous (Ph) is implanted.

[0010] In the aforementioned of a well structure in a high voltage device according to another embodiment of the present invention, the second well is a P-well into which boron (B) is implanted.

[0011] In the aforementioned of a well structure in a high voltage device according to another embodiment of the present invention, the field stop implant region is formed by implanting boron (B).

[0012] In the aforementioned of a well structure in a high voltage device according to another embodiment of the present invention, the spaced

distance between the first well and the field stop implant region is in the range of 0.5 μm to 1.5 μm .

[0013] In the aforementioned of a well structure in a high voltage device according to another embodiment of the present invention, the spaced
5 distance between the second well and the field stop implant region is 0.5 to 1.5 μm .

[0014] In the aforementioned of a well structure in a high voltage device according to another embodiment of the present invention, the pick-up region is formed by implanting boron (B) with high concentration.

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BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The above and other objects, features and advantages of the present invention will become apparent from the following description of preferred embodiments given in conjunction with the accompanying drawings,
15 in which;

[0016] FIG. 1 is a cross-sectional view illustrating a basic well structure in a conventional high voltage device;

[0017] FIG. 2 is a cross-sectional view illustrating a well structure in a high voltage device according to an embodiment of the present invention; and

20 **[0018]** FIG. 3 illustrates a simulation result that an N-well breakdown voltage is measured while varying the distance between a field stop implant region and an N-well.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0019] The present invention will now be described in detail in connection with preferred embodiments with reference to the accompanying drawings.

[0020] FIG. 2 is a cross-sectional view illustrating a well structure in a high voltage device according to an embodiment of the present invention. The proposed well structure may be applied to a NAND type flash memory, an NOR type flash memory and all the semiconductor devices, which require a high voltage.

[0021] Referring to FIG. 2, a first well 22 is formed by implanting an impurity of a conductive type different from a substrate 21 into the substrate 21. A first transistor for a high voltage is contained in the first well 22 by means of a common process. A second well 23 is isolated from the first well 22 and is formed by implanting an impurity of the same conductive type to the substrate 21 into the substrate 21. A second transistor for a high voltage is contained in the second well 23 by means of a common process. A field stop implant region 24 is formed between the first well 22 and the second well 23 by implanting an impurity of the same conductive type to the substrate 21 into the substrate 21. At this time, the field stop implant region 24 is spaced apart from each of the first well 22 and the second well 23 by a given distance. A pick-up region 26 has the same conductive type to the field stop implant region 24 and is overlapped on the field stop implant region 24.

[0022] In a high voltage device, the substrate 21 is mainly a P type substrate. Therefore, the first well 22 becomes an N well by implanting the impurity of the conductive type different from the substrate 21, for example,

phosphorous (Ph). Further, the second well 23 becomes a P well by implanting the impurity of the same conductive type to the substrate 21, for example, boron (B).

[0023] In the above, the field stop implant region 24 may be formed by
5 implanting the impurity of the same conductive type to the substrate 21, for example boron (B) before a deposition process of HDP oxide for forming a field oxide film 25 after an ISO etch process in the process of manufacturing the flash memory, or may be formed by implanting boron (B) through additional process other than the process of manufacturing the flash memory.

10 **[0024]** The field stop implant region 24 is spaced apart from the first well 22 being the N-well by a given distance. This allows phosphorous (Ph31) of the first well 22 and boron (B) of the field stop implant region 24 not to directly meet, thus improving the well breakdown voltage. FIG. 3 illustrates a simulation result that the N-well breakdown voltage is measured while varying
15 the distance between the field stop implant region and the N-well in the NAND type flash memory of 0.12 μm level. It can be seen from FIG. 3 that the well breakdown voltage is about 23V when the distance between the field stop implant region 24 and the first well 22 is 0.0 μm . Further, it can be seen that, when the distance is 0.5 μm or greater, the N-well breakdown voltage of about
20 30V or higher can be obtained. Accordingly, in order to improve the well breakdown voltage of the high voltage device, the field stop implant region 24 is formed between the first well 22 and the second well 23, wherein the distance between the first well 22 and the field stop implant region 24 is spaced apart 0.5 μm or greater, preferably 0.5 to 1.5 μm .

[0025] Further, the field stop implant region 24 is spaced apart from the second well 23 being the P-well by a given distance. This considers characteristics of the NMOS transistor formed in the second well 23 being the P-well. In the concrete, this is for reducing a body factor effect. The spaced
5 distance needs not to be limited but may be set 0.5 μm or greater, preferably 0.5 to 1.5 μm .

[0026] The pick-up region 26 is formed by implanting the impurity of the same conductive type to the field stop implant region 24, for example, boron (B) with a high concentration. This is for preventing charge-up and
10 latch-up at the P type substrate 21. In other words, as the resistance of the P type substrate 21 is high, charges may locally gather within the P type substrate 21. For this reason, a latch-up may occur and erroneous function may be caused. In order to prevent them, the pick-up region 26 is formed using the same conductive type impurity to the field stop implant region 24.

15 **[0027]** According to the present invention described above, the present invention can improve performance and reliability of a device and realize higher-integration of the device, by improving a well breakdown voltage and preventing charge-up and latch-up at a substrate.

[0028] Although the present invention has been described in connection
20 with the embodiment of the present invention illustrated in the accompanying drawings, it is not limited thereto. It will be apparent to those skilled in the art that various substitutions, modifications and changes may be made thereto without departing from the scope and spirit of the invention.